Determinants of vitamin D in a Multi-ethnic sample of Auckland residents

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Abstract. People in New Zealand have low levels of vitamin D compared to other countries. Suboptimal levels of serum 25-hydroxyvitamin D [25(OH)D] are associated with a range of different diseases, including cancer, heart disease, diabetes and high blood pressure. This cross-sectional study aims to determine factors that influence vitamin D status in a multi-ethnic sample of Auckland residents. Mean 25(OH)D varied with season, with the level higher in autumn compared to winter ($p<0.0001$). Mean 25(OH)D also varied with age, where levels were lower in ages 34-49 y than in 65-85 y ($p=0.018$). Females had higher mean 25(OH)D than males ($p=0.009$), and among the ethnic groups, Europeans had the highest and Asian & Other the lowest ($p<0.0001$). Those who liked to get a suntan had higher mean 25(OH)D levels compared to those who didn't ($p=0.026$). Mean levels of 25(OH)D did not vary with frequency of sunscreen usage.

Background

New Zealanders have low vitamin D levels (measured as serum 25-hydroxyvitamin D [25(OH)D]) (Livesey *et al.*, 2008 ; Rockell *et al.*, 2006). The levels vary with ethnicity, with the lowest found in Pacific and the highest in Europeans (Rockell *et al.*, 2006). Studies also indicate a seasonal variation in 25(OH)D, with highest levels during summer and autumn, and lowest during winter (Livesey *et al.*, 2008; Rockell *et al.*, 2006). This may be due to the differences in UVB irradiance, which is the strongest determinant of vitamin D status (Webb *et al.*, 2006). Irradiation of skin with UVB initiates the photochemical conversion of 7-dehydrocholesterol to vitamin D_3 (Webb *et al.*, 2006). The skin melanin content absorbs UVB radiation, and reduces the amount vitamin D3 produced per time unit (Holick, 2004; Webb *et al.*, 2006) Personal UV irradiation varies with individual- (ethnicity, age, clothing, and personal behaviour) and ecological factors (latitude, season, time of day, ozone amount, cloud amount, aerosol and reflectivity of the surface) (Webb *et al.*, 2006).

Levels of 25(OH)D between ~80-125 nmol/L are considered to be in the optimal range, and concentrations lower than this may be associated with increased risk of cancers, heart disease, high blood pressure, diabetes, infections, fractures, myopathy, autoimmune diseases, osteomalacia and rickets (children) (Holick, 2004).

The aim of this study was to identify determinants of 25(OH)D concentrations in a multi-ethnic sample of Auckland residents.

Methods

This is a cross-sectional study, funded by Health Research Council of New Zealand, with 317 adult volunteers (age 18-85 years) recruited from community groups in Auckland. The sample had twice as many females as males and a wide ethnic distribution. Throughout 2008-09 the volunteers completed a baseline questionnaire on demographic variables, sun-behaviour (including sunscreen usage) and attitudes towards sun tanning. Four weeks later, a blood sample was taken to measure 25(OH)D using Liquid Chromatography-Tandem Mass Spectrometry in Christchurch. The date when the individual's blood samples were taken, was used to divide the study sample into three seasonal groups. Mar-May was defined as autumn, Jun-Aug as winter and Sep-Nov as spring (no blood tests were taken during Dec-Feb). The baseline questionnaires were analysed along with the 25(OH)D measurements, using the Chi-square test & analysis of variance (SAS, v. 9.1).

Results

The unadjusted mean 25(OH)D in the study sample (n=317) was 56.9 (SD 28.6) nmol/L. Concentrations of 25(OH)D varied with demographics and season (Table 1). Mean 25(OH)D was higher in females than males, and also varied with age, being higher in ages 65-85 y compared to 35-49 y. The mean 25(OH)D was highest in Europeans, followed by Maori, then Pacific, and lowest in Asian & Other. It also varied with season, being higher in autumn (March-May) than winter and spring.

The proportion of those who liked to get a suntan varied with age, being largest in ages 18-34 y (47%), followed by 35-49 y (31%), 50-64 y (26%), and the lowest found in ages 65-85 y (24%) ($p=0.005$). A trend was seen in the proportion of those who liked to get a suntan by ethnicity. Although not significant ($p=0.1$) the highest proportion was found in Europeans (41%), followed by Maori (34%), then Pacific (30%), and then Asian & Other (22%). Mean 25(OH)D was higher in the group who liked to get a suntan than in those who did not (Figure 1).

Sunscreen use was more common in females than males ($p=0.0005$), and was highest in ages 18-34 y and declined with increasing age ($p<0.0001$). Frequency of sunscreen usage varied with ethnicity, being highest in Europeans, followed by Asian & Other, and then Maori, and lowest in Pacific ($p<0.0001$). There was no association between sunscreen use and 25(OH)D (Figure 2).

Variables	25(OH)D mean (SE) nmol/L	Mean Difference (SE)	P-value
Sex			
Female (n=206)	59.4 (1.7)	7.9 (3.0)	0.01
Male* (n=111)	51.5 (2.4)	-	-
Age group (years)			
18-34 (n=83)	56.7 (2.7)	7.5 (4.1)	0.07
35-49 * (n=72)	49.2 (3.1)	-	-
50-64 (n=86)	56.4 (2.7)	7.2 (4.0)	0.07
65-85 (n=76)	59.2 (2.9)	10.0 (4.2)	0.02
Ethnic group			
European (n=68)	65.7 (3.1)	23.6 (4.1)	<0.0001
Maori (n=87)	60.9 (2.7)	18.8 (3.9)	<0.0001
Pacific (n=86)	52.8 (2.8)	10.7 (3.9)	0.007
Asian & Other (n=76)	42.1 (2.9)	-	-
Season			
Mar-May (n=104)	71.9 (2.5)	27.7 (3.5)	<0.0001
Jun-Aug* (n=92)	44.2 (2.7)	-	-
Sep-No) (n=118)	50.1 (2.4)	5.9 (3.6)	0.10

Table 1. Mean 25(OH)D by age, ethnicity, gender & season adjusted for each other. *Reference category for mean difference and p-value

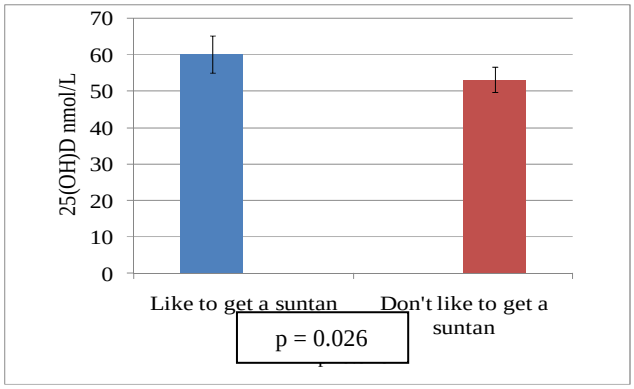

Figure 1. Mean 25(OH)D by whether or not 'like to get a suntan' adjusted for season, gender, ethnicity & age.

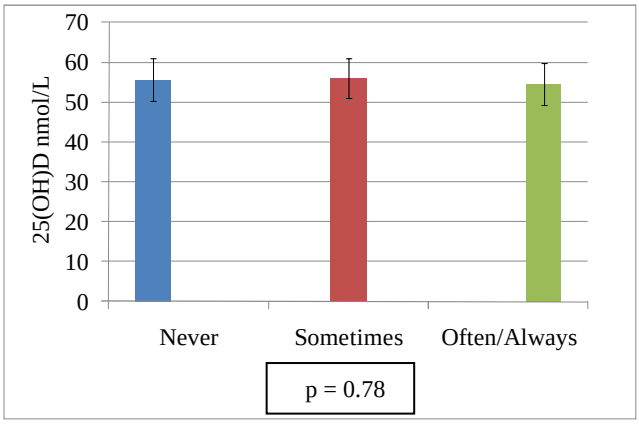

Figure 2. Mean 25(OH)D by frequency of sunscreen use adjusted for season, gender, ethnicity & age.

Discussion

The study sample mean 25(OH)D level is lower than optimal, in accordance to previous studies carried out in New Zealand (Livesey *et al.*, 2008; Rockell *et al.*, 2006). This may predispose Auckland residents to a number of diseases. The seasonal and ethnical variations in 25(OH)D, seen in this study are consistent with previous publications (Livesey *et al.*, 2008; Rockell *et al.*, 2006; Webb *et al.*, 2006). Few studies carried out in New Zealand, to our knowledge, have had people with Asian origin as a main part of an ethnic group. This makes the study results, referring to Asian & Other, of special interest. People in the ages 35-49 y had significantly lower mean 25(OH)D levels compared to ages 65-85 y. This may possibly be explained by a higher fraction of time spent outdoors by the latter.

Females had higher mean 25(OH)D than males; this finding is inconsistent with the results of previous publications (Rockell *et al.*, 2006; Scragg *et al.*, 2007). Females used sunscreen to a higher extent than males, but frequency of sunscreen usage was not associated with 25(OH)D levels. Frequency of sunscreen usage declined with increasing age. It also varied with ethnicity, being highest in Europeans and lowest in Pacific. The lack of correlation between sunscreen usage and 25(OH)D levels could be explained by increased sun exposure in those who use sunscreens.

This study indicates an association between 25(OH)D levels and a positive attitude towards sun tanning. The proportion of those who liked to get a suntan declined with age. A trend was seen among the different ethnicities, with the proportion of those who liked to get a suntan being highest in Europeans and lowest in Asian & Other.

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